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I, JANENE PEISKER, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002952176 for a patent by CRC FOR MINING TECHNOLOGY & EQUIPMENT as filed on 18 October 2002.

I further certify that the name of the applicant has been amended to CMTE DEVELOPMENT LIMITED pursuant to the provisions of Section 104 of the Patents Act 1990.



WITNESS my hand this  
Seventh day of November 2003

JANENE PEISKER  
TEAM LEADER EXAMINATION  
SUPPORT AND SALES

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**PATENTS ACT 1990**

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**PROVISIONAL SPECIFICATION**

***FOR THE INVENTION ENTITLED:-***

**"DRILL HEAD STEERING"**

**The invention is described in the following statement:-**

## DRILL HEAD STEERING

This invention relates to drill head steering and has been devised particularly though not solely for the direction control of a fluid drilling head used in tight radius drilling.

5 Fluid drilling heads are utilised in a number of different borehole drilling applications and typically use a rotating head with a number of nozzles from which issue high pressure jets directed to break and erode the rock face in advance of the drill head. Fluid drilling heads of this type are described in international patent application PCT/AU96/00783.

10 One difficulty with fluid drilling heads of this type is controlling the direction of the head. In most applications it is highly desirable to achieve directional accuracy in the formation of a bore hole particularly in situations such as the draining of methane gas from coal seams preparatory to mining. In such situations, it is critical to achieve an even pattern of drainage bores, and to ensure that the bores are accurately placed to pass  
15 through proposed roadway locations in the mining operation.

In the past it has been difficult to accurately control or steer a fluid drilling head of this type which is fed via a flexible hose, typically from a surface drilled location via a tight radius drilling configuration.

The present invention therefore provides a method of steering a fluid drilling head  
20 of the type provided with high pressure fluid through a flexible hose, including the steps of providing a biasing force to the drilling head and controlling the direction of the biasing force by rotating the drilling head.

Preferably the step of rotating the drilling head is performed by rotating the flexible hose.

25 Preferably the flexible hose is rotated from a location remote from the drilling head.

In one form of the invention, the fluid drilling head is deployed from ground level and said location remote from the drilling head is located at or above ground level.

Preferably the hose is fed from a rotatable drum having a substantially horizontal  
30 axis of rotation, and the hose is rotated by rotating the drum and associated support gear about a vertical axis substantially aligned with a vertical bore through which the hose is fed into the ground.

Alternatively the hose is rotated by a powered swivel.

Alternatively the hose is rotated by a non-powered ratcheting swivel.

Preferably, the biasing force is provided by an asymmetrical gauging ring located on the fluid drilling head.

Alternatively the biasing force is provided by partial shading of a cutting jet on the  
5 head.

Alternatively the biasing force is provided by asymmetrical retro jet sizing on the cutting head.

Alternatively the biasing force is provided by a partially deflected retro jet.

Notwithstanding any other forms that may fall within its scope, one preferred form  
10 of the invention will now be described by way of example only with reference to the accompanying drawings in which:

Fig. 1 is a horizontal section through a proposed underground mine roadway configuration showing the desired location of boreholes for mine gas drainage;

Fig. 2 is a diagrammatic vertical section through a typical tight radius drilling  
15 arrangement using a fluid drilling head fed by a flexible hose;

Fig. 3 is a diagrammatic perspective view of a rotatable hose feed rig according to the invention;

Fig. 4 is a diagrammatic perspective view of a rig similar to that shown in Fig. 3 when mounted on a truck or trailer;

20 Fig. 5 is a diagrammatic view of a ratcheting swivel used to effect hose rotation in an alternative form of the invention; and

Fig. 6 is a perspective view of the forward end of a fluid drilling head showing an asymmetrical gauging ring used to provide a biasing force to the drilling head.

The preferred form of the invention will be described with reference to a typical  
25 mine gas drainage situation where a vertical bore is drilled from ground surface and a whipstock used to provide radial bores extending outwardly from the vertical bore at predetermined depths, but it will be appreciated that the method according to the invention can be utilised in many other fluid drilling situations including horizontal drilling from an underground location.

30 Fig. 1 shows a typical mine gas drainage drilling operation where it is desired to drain methane or other dangerous gasses from coal seams 1 in the location of intended roadways 2 to be cut as part of the mining operation. The mine gas drainage can be achieved safely and economically by drilling a number of vertical bores 3 from the

surface and using tight radius drilling techniques to drill radial bores such as those typically shown at 4 from the vertical bores 3. It will be noticed that the radial bores must be accurately controlled in direction so as to pass through each of the separate panels in the roadways 2.

5       The tight radius drilling system can be more accurately seen in Fig. 2 where the vertical bore 3 is drilled from ground surface 5 and tubing 6 fed down the vertical bore to support a whipstock 7 in a reamed cavity 8 in a desired location for drilling the radial bores in a coal seam 9.

10       The fluid drilling head 10 is fed with high pressure liquid (typically water) through a flexible hose 11 which passes through the tubing 6 and is horizontally diverted by an erectable arm 12 in the whipstock 7.

      The flexible tube is fed from the surface where it is stored on a rotatable drum 20 mounted on a surface rig 13 about a horizontal axis 14.

15       The surface rig may also incorporate other items such as a further drum 15 for a control bundle 16 and guide sheaves (not shown) arranged to direct the hose and control bundle into alignment into the vertical bore 3.

      The hose reel 20 is provided with high pressure water via a feed hose 18 from a high pressure pump 19.

20       In order to provide steering control to the fluid drilling head 10, in order to control the vertical location of the head and keep it within the coal seam 9, and in order to direct the head in the required direction to achieve drilling patterns of the type shown in Fig. 1, the head is provided with a biasing force tending to bias or deviate the drilling head to follow a curved path. The biasing force is then orientated by rotating the drilling head by rotating the flexible hose 11. This may be achieved in a number of different ways as  
25       will be described further below.

      The biasing force may be provided in a number of different ways but it has been found preferable to provide the force by using an asymmetrical gauging ring located on the fluid drilling head.

30       Our co-pending Australian patent application PR8864 describes a fluid drilling head having a gauging ring and it has been found a very simple modification to make the leading edge of the gauging ring asymmetrical as shown in Fig. 6. In this configuration, the gauging ring 20 which is concentrically mounted about the rotatable fluid jet head 21 is made asymmetrical either by having the leading edge 22 of the ring more advanced on

one side of the head than the other, or by otherwise shaping the leading edge of the gauging ring in other asymmetrical manners. In this way, the fluid issuing from a side facing reaming jet nozzle 23 may be partially impeded or deflected by the leading edge of the gauging ring at one point in the rotation of the head 21 so as to provide an uneven  
5 or biased lateral force tending to send the fluid drilling head on a curved trajectory.

Alternative methods of providing a biasing force to the drilling head can be provided by offsetting the force from the retro jets used to propel the head forward as described in international patent specification PCT/AU96/00783 either by making one jet larger than the others or by partially deflecting one of the retro jets at a more extreme  
10 angle to the axis of the drilling head than the other jets.

The preferred method of rotating the flexible hose 11 and hence the fluid drilling head 10 to orientate the biasing force in the required direction is achieved by rotating the entire surface rig 13 about the vertical axis of the flexible tube 11 where the tube feeds downwardly into the vertical bore 3. This configuration is shown diagrammatically in  
15 Fig. 3 where the surface rig 13 is rotated in a horizontal plane about a turntable 24, typically supported on the turntable by rollers 25 and at the outer end of the rig by circumferentially orientated wheels 26. In this manner, the entire surface rig is able to be rotated to effect rotation of the flexible hose 11.

As shown in Fig. 4, it is possible to mount this entire rig on the bed 27 of a truck  
20 or trailer so that the rig can be rotated, once again about the vertical portion of the flexible hose 11, allowing the entire hose to be rotated as it is fed downwardly through the bed of the truck.

Any rotation of the rig 13 as a rotary table, translates into a corresponding rotation of the hose length around its longitudinal axis, and thereby can be used to position the  
25 drill bias at any desired roll value. The necessary services that need to be connected into the rotary table or hose drum system include high pressure water, electrical power and instrumentation data cables. A high pressure water swivel can be located above the reeve frame along the axis of rotation of the table. A crude but effective method for connecting power and data cables is to wind these cables from a supply drum mounted  
30 on the semi-trailer base 27, directly onto a drum mounted onto the rotary table. Sufficient cable could be supplied to allow for e.g. 100 turns of the rotary table, considered unlikely to be achieved during the drilling of a controlled radial or lateral. At

the completion of a lateral, the cables are wound back onto the supply drums, ready for the drilling of another lateral.

This method of rotating the hose from the surface has the advantage that all system components are situated on the surface and out of the hole. This is an advantage in that  
5 the correct operation of the various components can be visually checked, and also facilitates maintenance and reliability issues. The system is able to achieve excellent control of the drilling bias orientation and is able to rotate the tool in both directions.

In alternative methods of rotating the flexible hose 11, various forms of powered or un-powered swivels may be used in the hose.

10 For example, a mid-hose powered swivel may be inserted into the hose, typically located in the vertical well during drilling operations. The swivel can be activated from the surface to index the desired rotation amount (only in one direction and in increments of some number of degrees). Separate power lines (hydraulic or electrical) are connected to the swivel for its operation, and as such need to be fed down the well  
15 during drilling operations. A sketch of a typical swivel is shown at 28 in Fig. 5.

In yet a further alternative way of rotating the hose, a non-powered ratcheting swivel can be mounted either directly behind the drilling head 10 or at a join in the hose somewhere within the vertical bore 3. A simple yet crude means of steering, this technique relies on the high pressure hose undergoing some form of twisting as a result  
20 of either a change of pressure within the hose, or changes in hose tension.

Changes in pressures and/or tension in the hose cause the hose to rotate relative to the hose drum 12. The rotation is absorbed by the ratcheting mechanism in the swivel, meaning that the ratcheting force must be less than the resistance to turn experienced by the drilling tool or the tool and hose combination against the borehole and the whipstock  
25 hose path. When re-pressurised/re-tensioned, the hose will rotate in the opposite direction.

The ratchet on the swivel prevents the hose from twisting back to its original position relative to the drilling tool, and the drilling tool is forced to twist as a result.

This technique relies on the ability to generate a controlled relative rotation of the  
30 hose swivel as water pressure or hose tension is varied. A complicating factor is the effect of hose pressure on hose length and hence tension.

By providing a biasing force to the fluid drilling head 10 and then controlling the direction of that force by rotating the flexible hose 11, preferably by rotating the entire

surface rig in the manner shown in Figures 3 and 4, accurate directional control of the drilling tool is achieved. Where it is desired to drive the tool in a "straight" line, the hose may be continuously rotated resulting in a shallow elongate spiral path for the drilling head, which approximates a straight line.

- 5       Where it is desired to turn in a specified direction, the drilling head is rotated so that the biasing force urges the drilling head in the required direction, and held in that orientation until the turn is complete.

Dated this 18th Day of October, 2002.

CRC for Mining Technology & Equipment

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Attorney: JOHN D. FORSTER

Fellow Institute of Patent and Trade Mark Attorneys of Australia  
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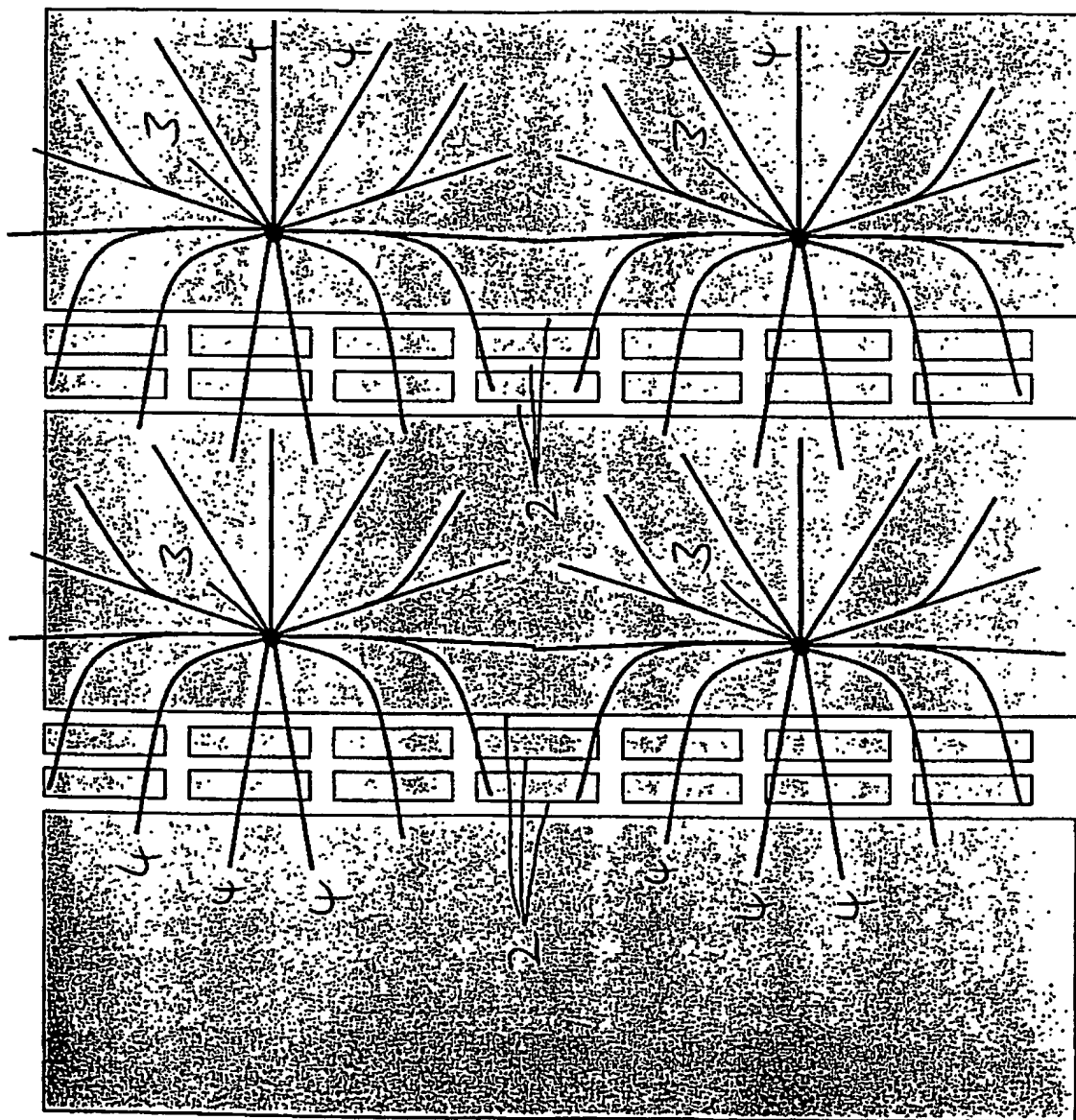


FIG. 1

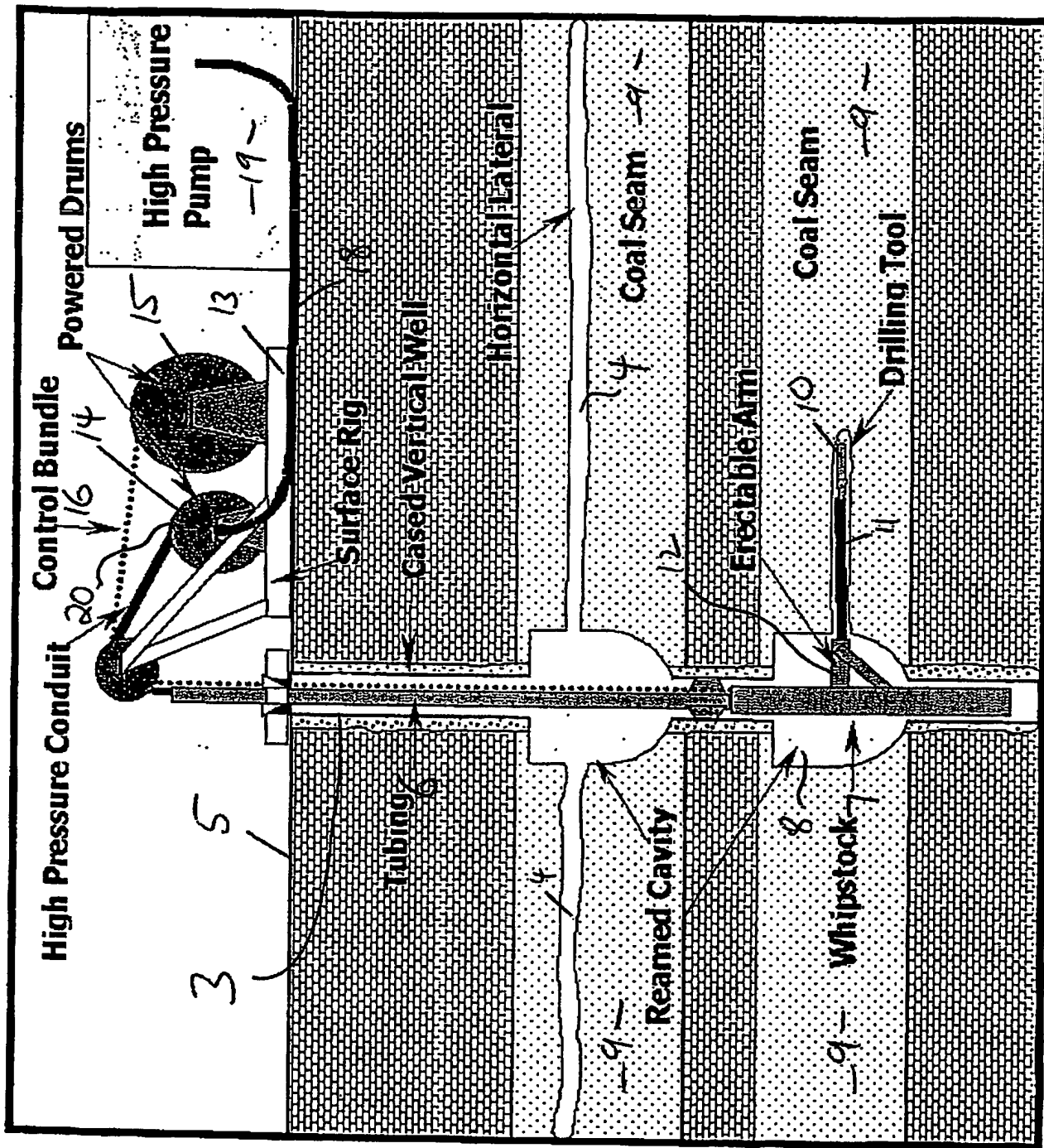


FIG 2

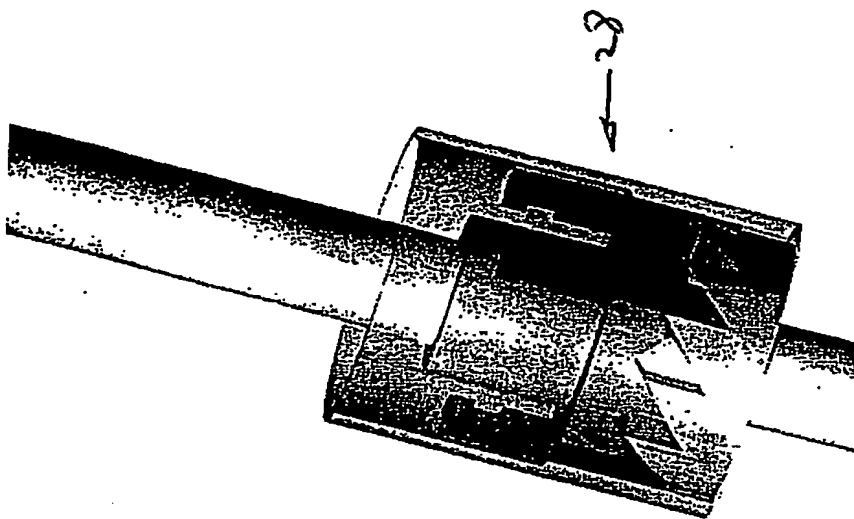


FIG. 5

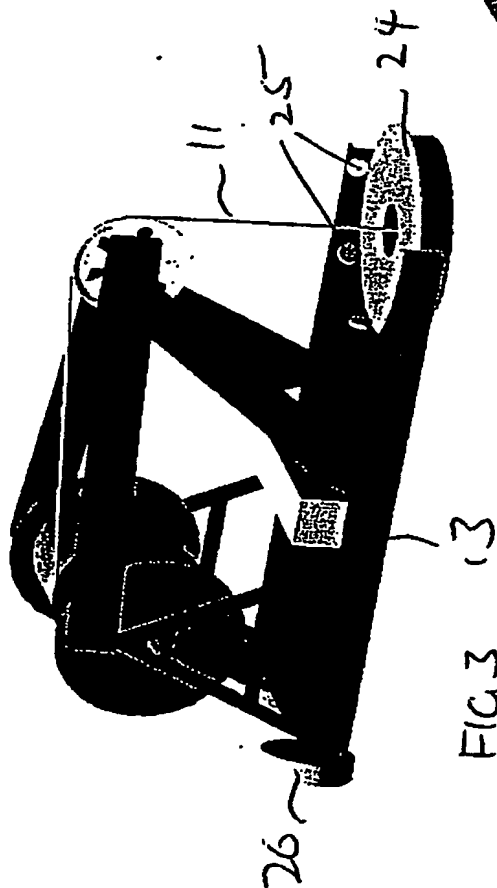


FIG. 3

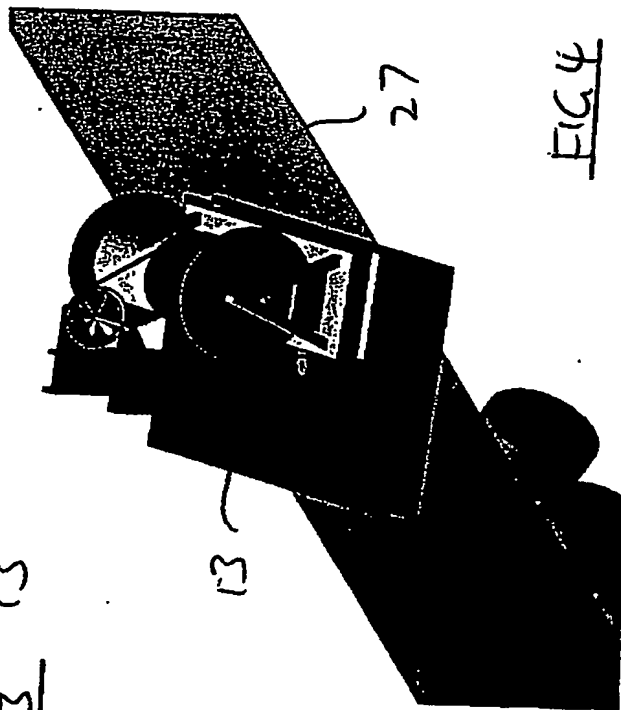


FIG. 4

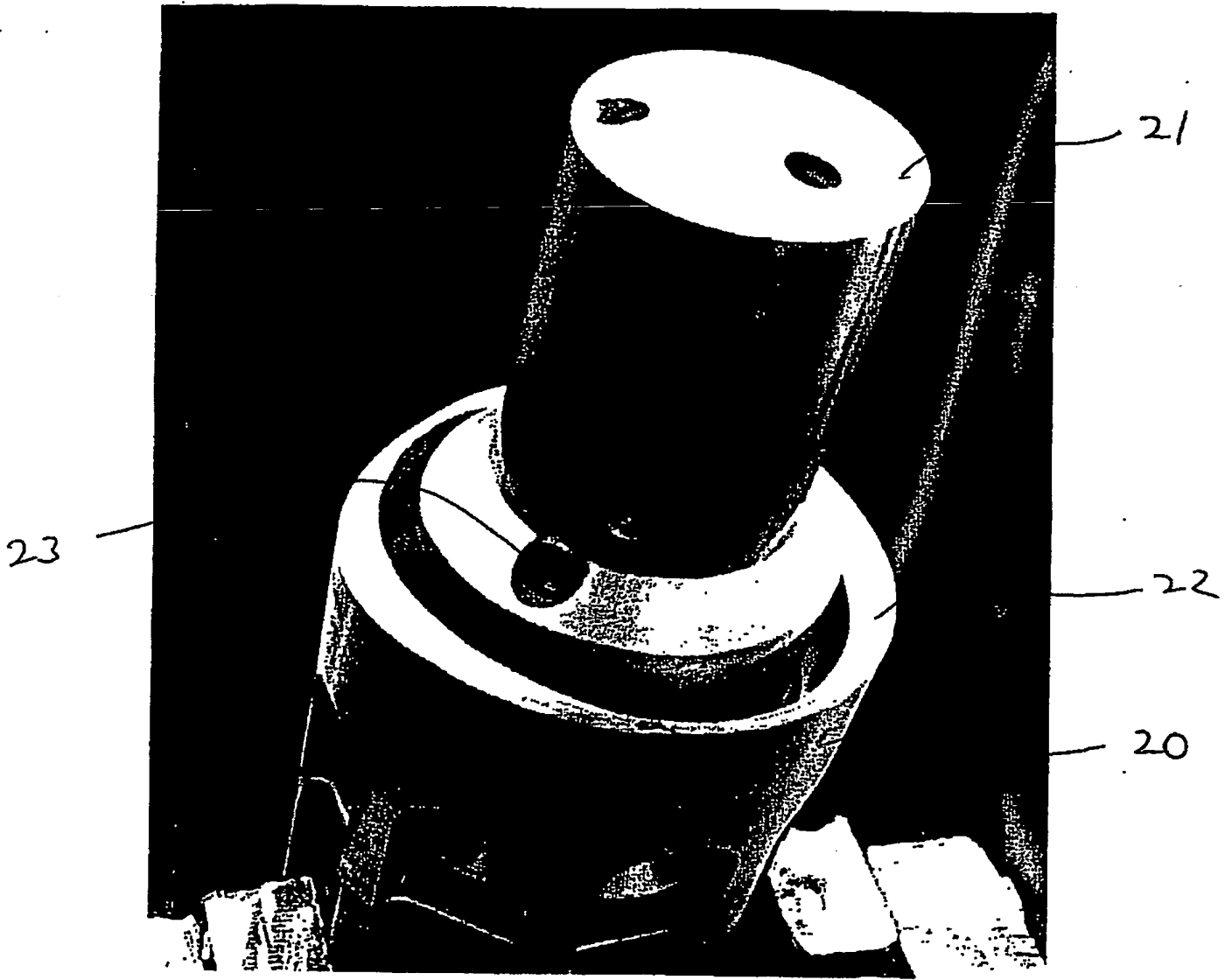


FIG 6

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